17.—Australites from northern Western Australia

by R. C. Horwitz[1] and D. R. Hudson[1]

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Abstract

Recent discoveries of tektites in the Patterson Ranges and western Pilbara regions indicate that australites are more abundant in northern Western Australia than was previously believed. They include the compositional varieties of normal australites and philippinites, indochinites, and high-Mg tektites, which supports the existence of a NNW-SSE trending primary distribution pattern extending from the Philippines through northern Western Australia to southern Australia. The present distribution of tektites in Western Australia has been influenced by geomorphological features. This has resulted in numerous tektite occurrences in areas such as the Eastern Goldfields, where concentration has occurred in playas, and relative scarcity of tektites in areas of fast drainage and dissection, such as the Ashburton River valley. Areas of sand cover or areas of recent sediment deposition also contributed to the apparent absence of tektites in northern Western Australia.

Introduction

Tektites are natural objects of silica-rich glass found in thousands on the surface of certain parts of the Earth. Baker (1959, p. 13) lists eight recognised true tektite provinces; those from Australia are designated australites and are believed to result from a single fall. Radiometric age data for australites are reviewed by Lovering *et al* (1972, p. 409) and the fall has been dated as about 700 000 years B.P. These authors also review (p. 408) and present new evidence concerning the relative age of the fall to geological and morphological features in the Quaternary.

The genesis of shapes and inner structures of australites is described and classified by Baker (1959). Their mode of preservation in present-day fields varies according to occurrences; i.e. well preserved in some scattered occurrences, to abraded pebbles in placer deposits and to dreikantered pebbles in desert areas of central Australia, such as the occurrences described by Johnson (1965) at Lake Wilson near the junction of the three states (W.A., S.A., N.T.). Australites have a strong mythological association for the Australian Aborigines of parts of Western Australia (R. C. Gould, pers. comm. 1965) and are found at aboriginal camp-sites and water holes, sometimes chipped and worked.

They occur most abundantly in the banks and on the floors of playas and internal drainage flats, where they are concentrated by drainage, in association with quartz pebbles and rocks of similar density.

Baker (1959, p. 31) estimates that 30 000 to 35 000 australites have been found. Cleverley and Dortch (1975, p. 243) refer to a "continental line of known occurrence" which they draw through about south of Geraldton to Lake MacKay and to south of Brisbane; this general northern boundary to the province (Figure 1) had been accepted following Baker (1959, p. 18). Cleverley and Dortch (1975) record that 23 occurrences of single australites exist north of this line in Western Australia; their paper discusses six australites found at archaeological sites of the eastern part of the Kimberley region.

Chapman *et al* (1964) studied specific gravities for tektites from Australia, Indonesia and Indo-China, grouping several tektite provinces under the heading Australasian tektites. Chapman and Scheiber (1969) established zones with varying chemical characteristics in Australasian tektites attributed by Chapman (1971) to a single fall erupted from Tycho (a Lunar Crater), with a spread on earth containing "streaks" of compositionally distinct tektites. This general spread differs from the distribution pattern accepted by Cleverley and Dortch (1975) in that it includes northern Australia, and in particular crosses northern Western Australia between about Exmouth and Derby.

This note is published to record that—(a) australite occurrences are more abundant in northern Western Australia than was previously believed; (b) in agreement with Chapman (1971) their distribution is best explained as primary in origin and related to NNW-SSE depositional streaks rather than to transport by man, as was believed by Cleverley and Dortch (1975); (c) to account for their relative absence from large areas of northern Western Australia; (d) to record some chemical compositions for northern Western Australian tektites and compare them to Chapman's model.

Australites in northern Western Australia

A minimum of nine australites, some intact, others worked, were found recently during exploration in the Patterson Ranges (Figure 1). A tektite was collected in 1974 near the mouth of the Sherlock River and some were found in the Teichmans-Pilbara townsite area (125 km ESE of Roebourne) during exploration in 1975 (M. J. Fitton, pers. comm. 1975). According to aboriginal stockmen, they occur in the Pilbara "north of Tom Price but are essentially absent from the Ashburton River valley". This river is conspicuous by its relative fast erosion compared to the areas of classical australite fields in the Eastern Goldfields.

The general dissection and fast drainage could have removed tektites and the surfaces on which they were deposited in most areas of the Pilbara and the Kimberley region of Western Australia and could contribute to their relative searcity in these areas.

Our observations in central Australia suggest that tektites get concentrated, as in the Eastern Goldfields and Lake Nabberu-Lake Carnegie regions, in small playas, resulting from natural damming on areas of bedrock (the Lake Wilson occurrence, described by Johnson 1965, is a typical occurrence. Here one of us (RCH) in 1965, found 53 small australites in 25 minutes over 77 m^2 marginal to the salt pan, in optimum conditions, with the back to the sun, as recom-

[1]CSIRO, Division of Mineralogy, Floreat Park, Western Australia, 6014.

mended by Baker 1959, p. 29). They are, however, not found in such concentrated patches in playas in interdunal hollows where the catchment area is smaller. A combination of sand cover or erosion with removal to the ocean (or burial in coastal deposits) could be sufficient to produce the apparent absence of tektites in northern Western Australia.

Distribution of compositional groups of tektites

Chapman (1971) has described the geographic distribution of tektite compositional groups for the southeast Asia-Indonesia-Australia region. He recognised a serious of compositional "streaks" with a general NNW-SSE trend. The most prominent of these in Australia are the high-Ca streak which extends from Alice Springs to the west coast of Tasmania, and the high-Mg streak which curves its way from the northern Philippines through Borneo and Java to cross the Australian coast between Exmouth and Derby and then extends SE towards Adelaide. These high-Mg tektites together with a ubiquitous population of normal australite-philippinites (some of which approach the high-Ca group) comprise the described tektite popuation of Western Australia. With the exception

Figure 1.—Map of Western Australia showing geomorphological divisions that have influenced the present distribution of australites. The areas without fast erosion and without sand-dune cover equate broadly with Salinaland and Euclonia of Jutson (1950, p. 22). Nos. 1-12 indicate the location of the analysed tektites referred to in the text.

of one high-Mg tektite from the Pilbara, all previously analysed Australian tektites reported by Chapman (1971) come from below the line described by Cleverley and Dortch (1975).

Compositions of tektites

Twelve tektites from localities in central and northern Western Australia have been analysed using the electron microprobe. The analyses were made in order to compare the compositions of the new tektite occurrences with those predicted from Chapman's (1971) distribution model. All analyses were made on polished chips of tektites mounted in epoxy resin. Refractive indices were determined on the chips using a Raynor gem refractometer, and specific gravtiy determinations were made by hydrostatic weighing. Operating conditions for the electron microprobe are given in Table 1.

With the exception of analyses 7 and 8 the totals are generally low, and this combined with a low and variable sodium determination (probably due to the sodium loss under the focussed electron beam) renders the analyses semiquantitative. Nevertheless, the element ratios are believed to be significant, and enable a classification of the tektites to be made (Figure 2) into the compositional groups of Chapman and Scheiber (1969).

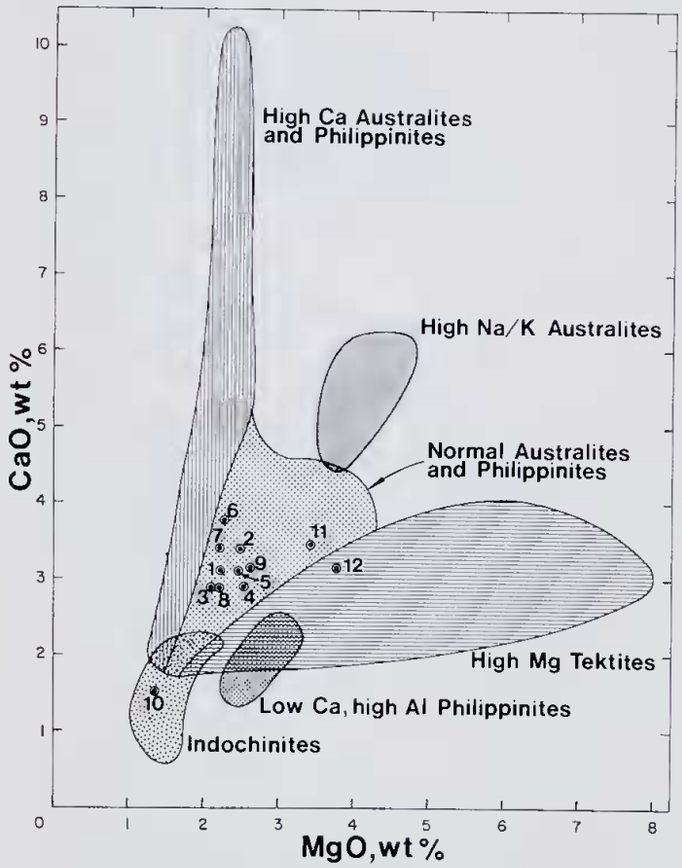

Figure 2.—Compositional grouping of tektites, based on the classification of Chapman and Scheiber (1969).

Analyses 1 to 9 are typical of the composition of "normal australites and philippinites" with MgO contents ranging from 2.13 to 2.57 weight percent. All three of the analysed tektites from the Lake Nabberu general area (including two tektites from the Canning Stock Route), three tektites from the Patterson Range and a tektite from the Kimberley district are thus of normal australite composition. Analysis 10 is of a tektite from the Kimberleys that falls within the "indochinite" compositional group, with low MgO and CaO contents of 1.27% and 1.50% respectively. Both analyses 11 (from Kimberleys) and 12 (from the Pilbara) are "high-Mg" tektites with MgO values of 3.38 and 3.73%.

The new analyses thus confirm the continuity of the high-Mg streak through the Pilbara-Canning Basin-Kimberley districts of Western Australia, and increase the known distribution of normal australite-philippinites to northern Western Australia.

The occurrence of an indochinite (analysis 10, from Miriwun) in the Kimberley district is puzzling. In Chapman's study this compositional group was found to be restricted to a small tear-shaped streak over southeast Asia. It is not inconsistent with Chapman's overall thesis that the indochinite distribution could extend to Australia, but the fact that the Miriwun tektite is a glass chip from an aboriginal site means that in this instance we cannot rule out the possibility of transport by man.

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Table 1

Chemical Analyses of Tektites

CSIRO No.	Western Australian Tektites*												Average Tektites†		
	1	2	3	4	5	6	7	8	9	10	11	12	High–Mg	Australite	Indochinite
SiO_2	68·78	67·67	67·79	68·53	69·39	70·03	71·68	71·26	69·13	75·58	69·71	67·35	70·18	71·32	75·50
TiO_2	1·04	0·84	0·94	0·93	0·94	0·71	0·68	0·73	0·83	0·69	0·80	0·74	0·71	0·81	0·70
Al_2O_3	13·31	12·62	12·03	12·20	12·24	11·58	12·80	13·00	12·55	10·27	11·30	11·65	12·08	13·36	11·86
FeO	4 54	4·60	4·61	4·73	4·61	4·33	4·83	4·99	4·41	3·75	5·09	5·36	6·38	4·81	4·24
MnO	0·04	0·06	0·08	0·09	0·05	0·05	0·11	0·10	0·12	0·05	0·09	0·06	0·13	0·10	....
MgO	2·21	2·46	2·13	2·57	2·41	2·20	2·18	2·13	2·56	1·27	3·38	3·73	4·59	2·27	1·68
CaO	3·05	3·39	2·85	2·82	3·05	3·80	3·38	2·80	3·13	1·50	3·41	3·11	2·76	3·22	1·63
Na_2O	1·31	0·56	0·17	0·94	0·39	0·79	1·30	1·04	0·13	0·18	0·60	0·80	1·00	1·44	1·42
K_2O	2·68	2·29	2·32	2·39	2·34	2·08	2·31	2·46	2·32	1·94	1·91	2·00	1·91	2·46	2·55
Total	96·96	94·49	92·92	95·20	95·42	95·57	99·27	98·51	95·18	95·23	96·29	94·80	99·74	99·79	99·58
SG	2·44	2·39	2·44	2·46	2·46	2·46	....	....	2·45	2·40	2·46	2·45	2·49	2·45	2·36
RI	1·514	1·522	1·523	1·520	1·518	1·520	....	....	1·512	1·500	1·515	1·516	1·524	1·513	1·501

* Microprobe analyses—MAC probe; MAGIC IV correction program; Standards—Ti/Ti (LIF), Mn/Mn (LIF), Fe/Fe (LIF), Si/Si (PET), K/Nepheline (PET), Ca/Apatite (PET), Na/Nepheline (RAP), Mg/MgO (RAP), Al/Al_2O_3 (RAP). 20 sec. counts, 19·3kV. Focussed electron beam. Analyses 7 and 8 by R.B.W. Vigers.
† Data from Chapman and Scheiber (1969).

Description of analysed tektites.

CSIRO No.	Location	Approx. Latitude South	Approx. Longitude East	
1	Nabberu	25° 33′	120° 33′	Abraded, elongate fragment of normal australite; 0·6 g.
2	Nabberu	25° 33′	120° 33′	Abraded, rounded fragment; normal australite; 0·5 g.
3	Nabberu	25° 33′	120° 33′	Abraded fragment; minor 20μm bubbles; normal australite; 1·2 g.
4	Canning	25° 34′	120° 48′	Fragment from elliptical normal australite; 18 x 12 mm; rare 20μm bubbles; 1·6 g.
5	Canning	25° 34′	120° 48′	Weathered hemispherical normal australite; some 40μm bubbles; 6·0 g.
6	Patterson	21° 46′	122° 17′	Abraded, eomplete "button" normal australite; 18 x 18 x 7 mm; 2·8 g.
7	Patterson	21° 46′	122° 17′	Abraded hemispherieal normal australite.
8	Patterson	21° 46′	122° 17′	Ellipsoidal normal australite with aboriginal shaping ehips, near Bwana R.H.; 38 x 35 x 20 mm; 28 g.
9	Gundarin Hill	16° 10′	128° 45′	Elliptical disc, normal australite; 28 x 21 x 9 mm; small aboriginal shaping ehips; 6·0 g.
10	Miriwun	16° 18′	128° 42′	Small greenish glass ehip of an indoehinite from an aboriginal site; 11 x 8 x 3 mm; 0·2 g.
11	Monsmont	16° 18′	128° 43′	Chip of high-Mg tektite; 17 x 10 x 4 mm; 0·8 g.
12	Sherlock	20° 45′	117° 37′	Vesieular, rounded to aeorn shaped high-Mg tektite; 20 x 18 x 18 mm; vesicules up to 1·5 mm diameter; 8·0 g.